REMARKS

Claims 1 to 20 appear in this application for the Examiner's review and consideration. The present claims are fully supported by the specification and claims as originally filed. Therefore there is no issue of new matter.

Claim 1 was rejected under 35 U.S.C. §102(e), as allegedly being anticipated by WO 03/020999A1 to Shtein et al. (Shtein) for the reasons set forth on pages 2 and 3 of the Office Action.

In response, Applicants submit that 35 U.S.C. § 102(e) states:

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, ***except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of this subsection of an application filed in the United States only if the international application designated the United States*** and was published under Article 21(2) of such treaty in the English language. (emphasis added)

Therefore, to be prior art under § 102(e), a reference must designate the United States. As Shtein does not designate the United States, that reference is not prior art under § 102(e).

Therefore, as Shtein is not prior art under 35 U.S.C. § 102(e), the present claims are not anticipated by that reference under 35 U.S.C. § 102(e). Accordingly, it is respectfully requested that the Examiner withdraw the rejection of claim 1 under 35 § U.S.C. 102(e) over Shtein.

Claims 1 to 3, 10, 14 to 18, and 20 were rejected under 35 U.S.C. §103(a), as allegedly being unpatentable over U.S. Patent No. 4,7887,082 to Schmitt in view of Stickney et al., "Angular Distribution of Flow from Orifices and Tubes at high Knudsen Number," J. Fac. Sci. and Tech., 4, 10-17 (1967) (Stickney) for the reasons set forth on pages 4 to 6 of the Office Action; claims 4, 5, 6, 9, 11 and 12 were rejected under 35 U.S.C. §103(a), as allegedly being unpatentable over Schmitt in view of Stickney and further in view of U.S. Patent No. 6,498,605 to Shah et al. (Shah) for the reasons set forth on pages 6 and 7 of the Office Action; claims 7 and 8 were rejected under 35 U.S.C. §103(a), as allegedly being unpatentable over Schmitt in view of Stickney and Shah and further in view of Kirk-Othmer, Encyclopedia of Chemical Technology, Fourth Ed., Vol. 24, "Vacuum Technology," 750-53 (1997) (Kirk-Othmer) for the reasons set forth on pages 7 and 8 of the Office Action; and

claims 13 and 19 were rejected under 35 U.S.C. §103(a), as allegedly being unpatentable over Schmitt in view of Stickney and Shah and further in view of U.S. patent No. 5, 709,906 to Bickford et al. (Bickford) for the reasons set forth on pages 8 and 9 of the Office Action.

In response, as discussed above, Applicants submit that the presently claimed invention directed to a method of depositing an organic material, comprising ejecting a carrier gas carrying an organic material from a nozzle at a flow velocity that is at least 10 % of the thermal velocity of the carrier gas, such that the organic material is deposited onto a substrate, separated from the nozzle. A region between the nozzle and the substrate surrounding the carrier gas has a dynamic pressure of at least 1 Torr, and at least one of the nozzle diameter, the nozzle length, and nozzle-to-substrate separation is about equal to the gas mean free path length.

Therefore, to be within the scope of the present claims, a reference must disclose or suggest ejecting a carrier gas and an organic material from a nozzle, where at least one of the nozzle diameter, nozzle length, and/or nozzle-to-substrate separation is about equal to the mean free path of the gas.

As stated in the Office Action at page 5, Schmitt fails to disclose providing a nozzle diameter, nozzle length, and/or nozzle-to-substrate separation that is about equal to the gas mean free path length. Moreover, Schmitt fails to provide any motivation for one of ordinary skill in the art to provide a nozzle diameter, nozzle length, and/or nozzle-to-substrate separation that is about equal to the gas mean free path length, as one of ordinary skill in the art will understand that the teachings of Schmitt require a nozzle diameter, nozzle length, and nozzle-to-substrate separation significantly greater than the gas mean free path length.

As stated in the Office Action at page 5, Schmitt discloses depositing a film from a carrier gas ejected from a nozzle, where the flow velocity is on the order of the speed of sound, column 19, lines 59 to 62, the deposited material can be an organic material, column 30, lines 21 to 38, and the background pressure can be 760 torr, column 24, lines 49 to 64.

Moreover, Schmitt also discloses

> In recent years, in the prior art much effort has been directed toward development of economically viable techniques for manufacturing various useful materials in the form of thin solid films which overlay a supporting solid substrate material, such as corrosion resistant materials, which provide chemical protection for the supporting material (e.g. an oxide coating on an aircraft engine's turbine blades). Column 1, lines 28 to 32.
>
> Because this deposition technique affords great flexibility and control in specifying these variables, there is a large number of

> chemical reactions which potentially could be induced to occur by the following described method. Column 7, lines 8 to 12.
>
> The flow geometry, flow speed and the carrier gas pressure can be arranged so that the synthesis of the depositing saturated vapor species occurs near the center of the forming jet and does not allow time for diffusion of those species to the walls of the apparatus which border [the jet]. Column 8, lines 22 to 27.

Schmitt also discloses that a precursor is introduced into the jet, R1, where, when the precursor is a gas or vapor species

> it can be mixed into the carrier far upstream and introduced into region R1 along with the carrier's 1-3 flow through the nozzle 1-1, where the pecursor [*sic*] 4-1 is then acted upon to synthesize a condensible species.
>
> * * *
>
> This mechanism may be employed to introduce metal-bearing gaseous molecules (say silane or an organo-metallic salt) which is then used to synthesize a depositing metal-vapor, or it may be used to introduce reactive gas (say oxygen or a halogen) which reacts with a metal vapor in the formation of a metal-compound deposit (say a metal-oxide). Column 9, lines 47 to 58, and Fig. 1.
>
> This wide variety of actions is possible in my invention, precisely because the transport of the highly reactive, saturated depositing species by a jet of carrier gas serves to spatially isolate the synthesis chemical reactions from the actual condensation reaction at the substrate surface. Column 10 lines 43 to 55.
>
> Once the synthesis reaction is started, it may continue as the reactant species are transported in the jet. Column 10, lines 61 to 62.
>
> Differences in the mixtures flow field as compared to that of the pure carrier fluid under the same fluid dynamic conditions will be mainly due to the possible disparity in masses of the mixtures constituent molecules and also due to the energy addition or consumption caused by the synthesis reactions. If one chooses to use a carrier gas with an especially small molecular weight (e.g. hydrogen or helium) then most depositing species will have a molecular weight which is one or several orders of magnitude greater (e.g. many metal or metal-oxide radicals). The possibility of dimerization, trimerization and ultimately cluster nucleation will increase this mass disparity, and with significant clustering the distinction between considering the behavior of the depositing species as that of molecules or as aerosol particles becomes less precise. Column 11, lines 48 to 63.

> Furthermore, by adjusting the position at which the synthesis reaction begins (e.g. by changing the placement of the filament in evaporation) and/or by changing the placement of the object to be coated, one can control the overall residence time of the depositing species in the gas-phase of the jet. This control of the residence time along with the wide latitude in setting the concentrations can be used to govern the synthesis reactions. Column 16, lines 29 to 37.
>
> In a flowing chemically reacting fluid under steady state conditions, the [r]eactions occur over distance; the time of the reaction is the time needed for the flow to convect the reactants over the distance and through the reaction. Thus the flow field not only determines the energetics of the reaction; the velocity field and apparatus' geometry (e.g. the nozzle to substrate distance, or length of the free jet.) will also determine the residence time of the reactant species in the gas-phase, and therefore the time of the reaction. More precisely, the concentration, self collision time, and residence time of the reactants will specify their probability of interaction. This probability along with the energy of this molecular interaction will determine the synthesis reactions. Both probability and energy can be largely controlled in this system . . .. Column 22, lines 29 to 44.

Therefore, Schmitt clearly discloses that chemical reactions occur in the disclosed jet.

As will be understood by one of ordinary skill in the art, the mean for path λ of a gas is the average distance between collisions of a molecule of the gas λ of gas, and, from kinetic theory can be calculated using the following equation.

$$\lambda = \frac{RT}{\sqrt{2}\pi d^2 N_A P}$$

In that equation, R is the universal gas constant, T is the temperature, d is the molecular (or, for the noble gases, the atomic) diameter, N_A is Avogadro's number, and P is the pressure. Using an atomic diameter of $2.56\text{X}10^{-10}$ m, i.e., 2.56 Å or 0.256 nm, for helium, the mean free path at temperature of 25°C and 1 Torr of pressure is about 0.11 mm. At 10 Torr, the mean free path is about 10.6 μm, and, at 760 Torr, i.e., 1 atmosphere, the mean free path is about 1.4×10^{-7} m or 0.14 μm. Larger molecules will clearly have a smaller mean free path under the same conditions.

As few collisions occur along a gas flow that is on the order of the mean free path, chemical reactions between molecules generally do not occur to any great extent over a gas flow on the order of the mean free path length. However, as stated above, the disclosure of Schmitt requires chemical reactions, which require molecular collisions, to occur within the disclosed nozzle and jet. This requires a nozzle diameter, the nozzle length, and

nozzle-to-substrate separation significantly greater than the gas mean free path length for the processes disclosed by Schmitt.

Moreover, as stated above, Schmitt discloses that the disclosed method and apparatus are intended for use in manufacturing materials in the form of thin solids that overlay a substrate, such as an oxide coating on the turbine blades of an aircraft engine, Column 1, lines 26 to 33. The disclosed processes can also be used to produce powdered materials or sheets of material by first depositing the material on a rotating drum, and, then, removing the material as a powder or film with a scraper. Practically, such processes require the coating of large areas quickly. In contrast, as stated in paragraph [0024] of the present specification, the processes of the presently claimed invention allow the formation of patterns having about 1000 dots per inch at a deposition rate that is measured in Å per second.

Thus, all of the disclosure of Schmitt is directed to processes in which having a nozzle diameter, nozzle length, and/or nozzle-to-substrate separation on the order of the mean free path length is inappropriate, if not impossible. Therefore, Schmitt provides no motivation to one of ordinary skill in the art to provide a nozzle diameter, nozzle length, and/or nozzle-to-substrate separation that is on the order of the gas mean free path length. Therefore, although Schmitt does not specifically teach away from the presently claimed invention, one of ordinary skill in the art would know from the teaching of Schmitt that a nozzle diameter, a nozzle length, and a nozzle-to-substrate separation significantly greater than the gas mean free path length are required by Schmitt.

In addition, as stated above, the mean free path for helium at 1 Torr is about 0.1 mm, and is shorter at higher pressures and for larger molecules. In contrast, the examples of Schmitt disclose nozzles that are 2 mm in diameter and 2 to 8 mm long, Fig. 17, and a nozzle-to-substrate distance that is greater than the gas mean free path length. Fig. 16. *See also*, column 23, lines 24 to 29.

Therefore, Schmitt does not disclose or suggest the presently claimed invention.

Stickney does nothing to overcome the deficiencies of Schmitt. Stickney discloses an investigation of the flow of cesium atoms from orifices and tubes into vacuum. *See* the abstract. Particular attention was given to the mean-free molecule flow regime, where the Knudsen number, defined as λ/D, the ratio of the mean-free path and the orifice or tube diameter, is on the order of unity. Page 10, first paragraph. As will be understood by one of ordinary skill in the art, the free molecule flow regime is the regime in which there are few if any molecular collisions in the flow. This is exactly the opposite of what is required in the processes disclosed by Schmitt.

Stickney does not disclose or suggest a nozzle diameter, a nozzle length, and/or a nozzle-to-substrate separation about equal to the gas mean free path length. Moreover, as Schmitt discloses reactions within the flow that require molecular collisions, and Stickney discloses an investigation of the free molecule flow regime from orifices and tubes, the combination of Schmitt and Stickney is improper.

Therefore, as the combination of Schmitt and Stickney is improper, and those references do not disclose or suggest the presently claimed invention, the claims are not obvious over those references.

Shah does nothing to overcome the deficiencies of Schmitt and Stickney. Shah discloses a deposition process for coating a substrate with an ultrasonically generated aerosol spray. Column 1, lines 16 to 18. Shah discloses that a shroud gas may be used to screen and shape the aerosol spray. Column 3, line 52, to column 4, line 6.

Shah does not disclose or suggest a nozzle diameter, a nozzle length, and/or a nozzle-to-substrate separation about equal to the gas mean free path length. Therefore, even if the disclosure of was combined with that of Schmitt and Stickney, where, as discussed above, the combination of Schmitt and Stickney is improper, the combination would not provide the presently claimed invention. Therefore, those references do not disclose or suggest the presently claimed invention.

Kirk-Othemer does nothing to overcome the deficiencies of Schmitt, Stickney, and Shah. Kirk-Othmer is an Encyclopedia of Chemical Technology that discloses that a pressure of less than 0.1 Torr is possible with vacuum technology. Kirk-Othmer does not disclose or suggest a nozzle diameter, a nozzle length, and/or a nozzle-to-substrate separation about equal to the gas mean free path length. Even if one of ordinary skill in the art combined the disclosures of Kirk-Othmer with those of the other cited references, the resulting combination would not provide the presently claimed invention.

Bickford does nothing to overcome the deficiencies of Schmitt, Stickney, and Shah. Bickford discloses a method of conditioning halogenated polymeric materials, where the method may be performed in a glove box that may be purged with an inert gas. Bickford does not disclose or suggest a nozzle diameter, a nozzle length, and/or a nozzle-to-substrate separation about equal to the gas mean free path length. Even if one of ordinary skill in the art combined the teaching of Bickford with those of the other cited references, the resulting combination would not provide the presently claimed invention.

Therefore, as the combination of Schmitt and Stickney is improper, and the combination of the cited references does not disclose or suggest the presently claimed

invention. It is respectfully requested that the Examiner withdraw the rejections of the claims over those references under 35 U.S.C. § 103(a).

Applicants thus submit that the entire application is now in condition for allowance, an early notice of which would be appreciated. Should the Examiner not agree with Applicants' position, a personal or telephonic interview is respectfully requested to discuss any remaining issues prior to the issuance of a further Office Action, and to expedite the allowance of the application.

An Extension-of-Time Transmittal is submitted herewith. Should any other fees be due, however, please charge such fees to Deposit Account No. 11-0600.

Respectfully submitted,

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Dated: June 12, 2006

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